C L A I M S

1. A packet communication network characterized by comprising a plurality of routers which are connected in a network form through communication links, and a plurality of route control servers each of which is arranged in one of areas provided by dividing the packet communication network and controls the router in the area,

wherein said route control server comprises a destination information acquisition unit which acquires destination information of a packet from header information of the packet, the header information being sent from said router in the area, a route control unit which generates inter-server information containing the destination information acquired by said destination information acquisition unit and transfer management information made to correspond to the destination information in advance, an inter-server information transmission/reception unit which transmits/receives the inter-server information to/from another route control server, and a packet control unit which determines an output interface of the packet in said router on the basis of the destination information and transfer management information and determines the output interface of the packet on the basis of destination information and transfer management information contained in inter-server information from another route

control server, and

said router comprises a header information acquisition unit which acquires the header information from the arrival packet and notifies the route control server of the acquired header information, and an output interface control unit which outputs the arrival packet from the output interface corresponding to the packet to a communication link connected to the output interface on the basis of the determination in said route control server.

2. A packet communication network according to claim 1, characterized by further comprising

a plurality of packet transfer apparatuses each of which is provided in each area to store a plurality of user terminals and connected to an optical wavelength path of the photonic network, encapsulates, in a lower layer frame, an upper layer packet received from one of a user network which stores a transmission source user terminal and an external network which stores the transmission source user terminal and transfers the lower layer frame, in transmitting the lower layer frame to the external network, transfers the lower layer frame after decapsulating the lower layer frame to the upper layer packet, and executes mutual conversion and transfer of an upper layer packet on a side of a user terminal corresponding to an upper layer packet address and a lower layer frame on a side of an

optical wavelength path corresponding to a lower layer frame address on the basis of an address management table which manages correspondence between the upper layer packet address and the destination lower layer frame address, and

an admission control server which is provided in each area and sets, of optical wavelength paths of the photonic network, an optical wavelength path to connect packet transfer apparatuses of transmission source and destination in accordance with an optical wavelength path connection request received from the transmission source user terminal through said packet transfer apparatus,

wherein said router comprises a frame transfer apparatus which is connected to the optical wavelength path of the photonic network to receive the lower layer frame from the transmission source packet transfer apparatus and transfer the lower layer frame to a packet transfer apparatus corresponding to the upper layer packet address of the upper layer packet in the lower layer frame, and

said admission control server comprises a route setting function unit which, in setting the optical wavelength path, registers correspondence between the upper layer packet address of the user terminal and the lower layer frame address corresponding to the optical wavelength path in the address management

tables of the packet transfer apparatuses of the transmission source and destination, sets, between the packet transfer apparatuses of the transmission source and destination, an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and passes through only at least one wavelength switch when a band guarantee request is present, and sets an optical wavelength path which connects the packet transfer apparatuses of the transmission source and destination through said frame transfer apparatus when no band guarantee request is present.

3. A packet communication network according to claim 2, characterized in that

said packet transfer apparatus manages correspondence between a destination upper layer packet address and a destination lower layer frame address in the address management table, converts the upper layer packet from the user terminal side into the lower layer frame, and transfers the lower layer frame to the optical wavelength path of the destination lower layer frame address corresponding to the destination upper layer packet address.

4. A packet communication network according to claim 2, characterized in that

said packet transfer apparatus manages correspondence between transmission source and

destination upper layer packet addresses and a destination lower layer frame address in the address management table, converts the upper layer packet from the user terminal side into the lower layer frame, and transfers the lower layer frame to the optical wavelength path of the destination lower layer frame address corresponding to the transmission source and destination upper layer packet addresses.

5. A route control server which is arranged in one of areas provided by dividing a packet communication network including a plurality of routers, characterized by comprising:

a destination information acquisition unit which acquires destination information of a packet from header information of the packet, the header information being sent from the router in the area;

a route control unit which generates inter-server information containing the destination information acquired by said destination information acquisition unit and transfer management information made to correspond to the destination information in advance;

an inter-server information transmission/reception unit which transmits/receives the inter-server information to/from another route control server; and

a packet control unit which determines an

output interface of the packet in the router on the basis of the destination information and transfer management information,

wherein said packet control unit determines the output interface of the packet on the basis of destination information and transfer management information contained in inter-server information from another route control server.

6. A route control server according to claim 5, characterized in that in transmitting the inter-server information, said inter-server information transmission/reception unit transmits the inter-server information to only a route control server in an area through which the packet having the destination information passes.

7. A route control server according to claim 5, characterized in that said packet control unit determines the output interface of the packet having the destination information on the basis of the destination information and transfer management information contained in the received inter-server information which said inter-server information transmission/reception unit has received from another route control server.

8. A route control server according to claim 7, characterized in that said packet control unit determines the output interface related to the destination information only when a subsequent area

through which the packet having the destination information of the inter-server information passes is present.

9. A route control server according to claim 5, characterized in that the transfer management information contains information representing one of priority and a size of a communication band in transfer processing of the packet having the destination information.

10. A route control method characterized by comprising:

the header information acquisition step of causing a plurality of routers which are connected in a network form through communication links to form a packet communication network to acquire header information from an arrival packet and send the header information to, of a plurality of route control servers each of which is arranged in one of areas provided by dividing the packet communication network and controls the router in the area, a route control server corresponding to the area of the router;

the destination information acquisition step of causing the route control server to acquire destination information of the packet from the header information of the packet, the header information being sent from the router in the area;

the route control step of causing the route

control server to generate inter-server information containing the destination information acquired in the destination information acquisition step and transfer management information made to correspond to the destination information in advance;

the inter-server information transmission/reception step of causing the route control server to transmit/receive the inter-server information to/from another route control server;

the packet control step of causing the route control server to determine an output interface of the packet in the router on the basis of the destination information and transfer management information and determine the output interface of the packet on the basis of destination information and transfer management information contained in inter-server information from another route control server; and

the output interface control step of causing the router to output the arrival packet from the output interface corresponding to the packet to a communication link connected to the output interface on the basis of the determination in the route control server.

11. A program which causes a computer of a route control server which is arranged in one of areas provided by dividing a packet communication network including a plurality of routers and controls the router in the area to execute:

the destination information acquisition step of acquiring destination information of a packet from header information of the packet, the header information being sent from the router in the area;

the route control step of generating inter-server information containing the destination information acquired in the destination information acquisition step and transfer management information made to correspond to the destination information in advance;

the inter-server information transmission/reception step of transmitting/receiving the inter-server information to/from another route control server; and

the packet control step of determining an output interface of the packet in the router on the basis of the destination information and transfer management information and determining the output interface of the packet on the basis of destination information and transfer management information contained in inter-server information from another route control server.

12. A recording medium which records a program to cause a computer of a route control server which is arranged in one of areas provided by dividing a packet communication network including a plurality of routers and controls the router in the area to execute:

the destination information acquisition step of acquiring destination information of a packet from header information of the packet, the header information being sent from the router in the area;

the route control step of generating inter-server information containing the destination information acquired in the destination information acquisition step and transfer management information made to correspond to the destination information in advance;

the inter-server information transmission/reception step of transmitting/receiving the inter-server information to/from another route control server; and

the packet control step of determining an output interface of the packet in the router on the basis of the destination information and transfer management information and determining the output interface of the packet on the basis of destination information and transfer management information contained in inter-server information from another route control server.

13. A packet communication network characterized by comprising:

a plurality of packet transfer apparatuses each of which stores a plurality of user terminals, is connected to an optical wavelength path of a photonic

network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function, encapsulates, in a lower layer frame, an upper layer packet received from one of a user network which stores a transmission source user terminal and an external network which stores the transmission source user terminal and transfers the lower layer frame, in transmitting the lower layer frame to the external network, transfers the lower layer frame after decapsulating the lower layer frame to the upper layer packet, and executes mutual conversion and transfer of an upper layer packet on a side of a user terminal corresponding to an upper layer packet address and a lower layer frame on a side of an optical wavelength path corresponding to a lower layer frame address on the basis of an address management table which manages correspondence between the upper layer packet address and the destination lower layer frame address;

an admission control server which sets, of optical wavelength paths of the photonic network, an optical wavelength path to connect packet transfer apparatuses of transmission source and destination in accordance with an optical wavelength path connection request received from the transmission source user terminal through said packet transfer apparatus; and

a frame transfer apparatus which is connected

to the optical wavelength path of the photonic network to receive the lower layer frame from the transmission source packet transfer apparatus and transfer the lower layer frame to a packet transfer apparatus corresponding to the upper layer packet address of the upper layer packet in the lower layer frame,

wherein said admission control server comprises a route setting function unit which, in setting the optical wavelength path, registers correspondence between the upper layer packet address of the user terminal and the lower layer frame address corresponding to the optical wavelength path in the address management tables of the packet transfer apparatuses of the transmission source and destination, sets, between the packet transfer apparatuses of the transmission source and destination, an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and passes through only at least one wavelength switch when a band guarantee request is present, and sets an optical wavelength path which connects the packet transfer apparatuses of the transmission source and destination through said frame transfer apparatus when no band guarantee request is present.

14. A packet communication network according to claim 13, characterized in that

said packet transfer apparatus manages

correspondence between a destination upper layer packet address and a destination lower layer frame address in the address management table, converts the upper layer packet from the user terminal side into the lower layer frame, and transfers the lower layer frame to the optical wavelength path of the destination lower layer frame address corresponding to the destination upper layer packet address.

15. A packet communication network according to claim 13, characterized in that

said packet transfer apparatus manages correspondence between transmission source and destination upper layer packet addresses and a destination lower layer frame address in the address management table, converts the upper layer packet from the user terminal side into the lower layer frame, and transfers the lower layer frame to the optical wavelength path of the destination lower layer frame address corresponding to the transmission source and destination upper layer packet addresses.

16. A packet transfer apparatus characterized in that said apparatus is used in a packet communication network formed from a network logically built on a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function, the packet communication

network comprising an admission control server which sets, of optical wavelength paths of the photonic network, one of an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and connects packet transfer apparatuses of transmission source and destination through only at least one wavelength switch and an optical wavelength path which connects the packet transfer apparatuses through a frame transfer apparatus in accordance with an optical wavelength path connection request received from the transmission source user terminal through the packet transfer apparatus, and comprises:

a forwarding processing unit which manages correspondence between a destination upper layer packet address and a destination lower layer frame address and executes mutual conversion of a destination address of a received packet between an upper layer and a lower layer on the basis of an address management table in which correspondence between an upper layer packet address of a user terminal which is stored in the packet transfer apparatus and a lower layer frame address corresponding to the optical wavelength path is registered in accordance with setting of the optical wavelength path from the admission control server;

a packet processing unit which encapsulates the upper layer packet received from the user terminal in the lower layer frame and decapsulates the lower

layer frame received from the optical wavelength path to the upper layer packet; and

a transmission frame processing unit which transfers the packet encapsulated by said packet processing unit to the optical wavelength path corresponding to the destination lower layer frame address obtained by said forwarding processing unit and transfers the packet decapsulated by said packet processing unit to the user terminal of the destination upper layer packet address obtained by said forwarding processing unit.

17. A packet transfer apparatus according to claim 16, characterized in that

said forwarding processing unit uses, as the address management table, an address management table in which correspondence between the upper layer packet address of a destination user terminal and the lower layer frame address corresponding to the optical wavelength path is registered in accordance with setting of the optical wavelength path from the admission control server, and

said transmission frame processing unit transfers the lower layer frame obtained by encapsulating the upper layer packet from the user terminal side to the optical wavelength path of the destination lower layer frame address obtained from the address management table in correspondence with the

destination upper layer packet address.

18. A packet transfer apparatus according to claim 16, characterized in that

said forwarding processing unit uses, as the address management table, an address management table in which correspondence between the upper layer packet addresses of transmission source and destination user terminals and the lower layer frame address corresponding to the optical wavelength path is registered in accordance with setting of the optical wavelength path from the admission control server, and

said transmission frame processing unit transfers the lower layer frame obtained by encapsulating the upper layer packet from the user terminal side to the optical wavelength path of the destination lower layer frame address obtained from the address management table in correspondence with the transmission source and destination upper layer packet addresses.

19. An admission control server characterized in that said admission control server is used in a packet communication network formed from a network logically built on a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function, the packet communication network comprising a packet

transfer apparatus which stores a plurality of user terminals, is connected to an optical wavelength path of the photonic network, and executes mutual conversion and transfer of an upper layer packet on a side of a user terminal corresponding to an upper layer packet address and a lower layer frame on a side of an optical wavelength path corresponding to a lower layer frame address on the basis of an address management table which manages correspondence between the upper layer packet address and the destination lower layer frame address, and comprises:

a route setting function unit which sets, of optical wavelength paths of the photonic network, an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and directly connects packet transfer apparatuses of transmission source and destination in accordance with an optical wavelength path connection request received from the transmission source user terminal through the packet transfer apparatus; and

an external device management function unit which registers correspondence between the upper layer packet address of the user terminal and the lower layer frame address corresponding to the optical wavelength path in the address management tables of the packet transfer apparatuses of the transmission source and destination in setting the optical wavelength path.

20. An admission control server according to claim 19, characterized in that in setting the optical wavelength path, said route setting function unit sets the optical wavelength path formed from the cut-through optical wavelength path between the packet transfer apparatuses of the transmission source and destination when a band guarantee request is present and sets an optical wavelength path which connects the packet transfer apparatuses of the transmission source and destination through a frame transfer apparatus to transfer the lower layer frame through the photonic network when no band guarantee request is present.

21. An admission control server according to claim 19, characterized by further comprising an optical wavelength path setting determination function unit which confirms presence/absence of the band guarantee request by referring to contract user information of a band guarantee service, which is registered in correspondence with each user terminal in advance, on the basis of the transmission source upper layer packet address of the transmission source user terminal contained in the optical wavelength path connection request.

22. An admission control server according to claim 19, characterized by further comprising a destination packet transfer apparatus specifying table which guides, from the destination upper layer packet

address, a destination lower layer frame address prefix representing the destination packet transfer apparatus which stores a user terminal having the address,

wherein said route setting function unit specifies the transmission source packet transfer apparatus on the basis of the transmission source lower layer frame address prefix contained in the optical wavelength path connection request, specifies the destination packet transfer apparatus on the basis of the destination upper layer packet address contained in the optical wavelength path connection request by looking up said destination packet transfer apparatus specifying table, and sets the cut-through optical wavelength path between the transmission source packet transfer apparatus and the destination packet transfer apparatus by controlling the transmission source packet transfer apparatus, the destination packet transfer apparatus, and the wavelength switch of the photonic network.

23. An admission control server according to claim 19, characterized in that in setting the optical wavelength path, by transmitting a table control packet to the packet transfer apparatus, said external device management function unit adds, to the address management table of the packet transfer apparatus, a destination lower layer frame address which corresponds to the destination upper layer packet address and contains a

lower layer frame address prefix representing the destination packet transfer apparatus and an identifier representing an optical wavelength path to be used.

24. An admission control server according to claim 19, characterized in that in setting the optical wavelength path, said external device management function unit adds, to the address management table of the packet transfer apparatus, a destination lower layer frame address which corresponds to the transmission source and destination upper layer packet addresses and contains a lower layer frame address prefix representing the destination packet transfer apparatus and an identifier representing an optical wavelength path to be used by transmitting a table control packet to the packet transfer apparatus.

25. An optical wavelength path setting method characterized by comprising:

the step of causing a plurality of packet transfer apparatuses each of which stores a plurality of user terminals and is connected to an optical wavelength path of a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function to encapsulate, in a lower layer frame, an upper layer packet received from one of a user network which stores a transmission source user terminal and an external network which stores the

transmission source user terminal and transfer the lower layer frame, in transmitting the lower layer frame to the external network, transfer the lower layer frame after decapsulating the lower layer frame to the upper layer packet, and execute mutual conversion and transfer of an upper layer packet on a side of a user terminal corresponding to an upper layer packet address and a lower layer frame on a side of an optical wavelength path corresponding to a lower layer frame address on the basis of an address management table which manages correspondence between the upper layer packet address and the destination lower layer frame address;

the step of causing a frame transfer apparatus which is connected to the optical wavelength path of the photonic network to receive the lower layer frame from the transmission source packet transfer apparatus and transfer the lower layer frame to a packet transfer apparatus corresponding to the upper layer packet address of the upper layer packet in the lower layer frame;

the step of causing an admission control server which is connected to the wavelength switch, the packet transfer apparatus, and the frame transfer apparatus to set, of optical wavelength paths of the photonic network, an optical wavelength path to connect packet transfer apparatuses of transmission source and destination in accordance with an optical wavelength

path connection request received from the transmission source user terminal through the packet transfer apparatus; and

the route setting function step of, in setting the optical wavelength path, causing the admission control server to register correspondence between the upper layer packet address of the user terminal and the lower layer frame address corresponding to the optical wavelength path in the address management tables of the packet transfer apparatuses of the transmission source and destination, set, between the packet transfer apparatuses of the transmission source and destination, an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and passes through only at least one wavelength switch when a band guarantee request is present, and set an optical wavelength path which connects the packet transfer apparatuses of the transmission source and destination through the frame transfer apparatus when no band guarantee request is present.

26. A program which causes a computer of a packet transfer apparatus provided in a packet communication network formed from a network logically built on a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function, the packet

communication network comprising an admission control server which sets, of optical wavelength paths of the photonic network, one of an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and connects packet transfer apparatuses of transmission source and destination through only at least one wavelength switch and an optical wavelength path which connects the packet transfer apparatuses through a frame transfer apparatus in accordance with an optical wavelength path connection request received from the transmission source user terminal through the packet transfer apparatus, to execute:

the forwarding processing step of managing correspondence between a destination upper layer packet address and a destination lower layer frame address and executing mutual conversion of a destination address of a received packet between an upper layer and a lower layer on the basis of an address management table in which correspondence between an upper layer packet address of a user terminal which is stored in the packet transfer apparatus and a lower layer frame address corresponding to the optical wavelength path is registered in accordance with setting of the optical wavelength path from the admission control server;

the packet processing step of encapsulating the upper layer packet received from the user terminal

in the lower layer frame and decapsulating the lower layer frame received from the optical wavelength path to the upper layer packet; and

the transmission frame processing step of transferring the packet encapsulated in the packet processing step to the optical wavelength path corresponding to the destination lower layer frame address obtained in the forwarding processing step and transferring the packet decapsulated in the packet processing step to the user terminal of the destination upper layer packet address obtained in the forwarding processing step.

27. A program which causes a computer of an admission control server provided in a packet communication network formed from a network logically built on a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function, the packet communication network comprising a packet transfer apparatus which stores a plurality of user terminals, is connected to an optical wavelength path of the photonic network, and executes mutual conversion and transfer of an upper layer packet on a side of a user terminal corresponding to an upper layer packet address and a lower layer frame on a side of an optical wavelength path corresponding to a lower layer frame address on the

basis of an address management table which manages correspondence between the upper layer packet address and the destination lower layer frame address, to execute:

the route setting function step of setting, of optical wavelength paths of the photonic network, an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and directly connects packet transfer apparatuses of transmission source and destination in accordance with an optical wavelength path connection request received from the transmission source user terminal through the packet transfer apparatus; and

the external device management function step of registering correspondence between the upper layer packet address of the user terminal and the lower layer frame address corresponding to the optical wavelength path in the address management tables of the packet transfer apparatuses of the transmission source and destination in setting the optical wavelength path.

28. A recording medium which records a program to cause a computer of a packet transfer apparatus provided in a packet communication network formed from a network logically built on a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path

switching function, the packet communication network comprising an admission control server which sets, of optical wavelength paths of the photonic network, one of an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and connects packet transfer apparatuses of transmission source and destination through only at least one wavelength switch and an optical wavelength path which connects the packet transfer apparatuses through a frame transfer apparatus in accordance with an optical wavelength path connection request received from the transmission source user terminal through the packet transfer apparatus, to execute:

the forwarding processing step of managing correspondence between a destination upper layer packet address and a destination lower layer frame address and executing mutual conversion of a destination address of a received packet between an upper layer and a lower layer on the basis of an address management table in which correspondence between an upper layer packet address of a user terminal which is stored in the packet transfer apparatus and a lower layer frame address corresponding to the optical wavelength path is registered in accordance with setting of the optical wavelength path from the admission control server;

the packet processing step of encapsulating the upper layer packet received from the user terminal

in the lower layer frame and decapsulating the lower layer frame received from the optical wavelength path to the upper layer packet; and

the transmission frame processing step of transferring the packet encapsulated in the packet processing step to the optical wavelength path corresponding to the destination lower layer frame address obtained in the forwarding processing step and transferring the packet decapsulated in the packet processing step to the user terminal of the destination upper layer packet address obtained in the forwarding processing step.

29. A recording medium which stores a program to cause a computer of an admission control server provided in a packet communication network formed from a network logically built on a photonic network including a transmission link having an optical wavelength path multiplex transmission function and a wavelength switch having an optical wavelength path switching function, the packet communication network comprising a packet transfer apparatus which stores a plurality of user terminals, is connected to an optical wavelength path of the photonic network, and executes mutual conversion and transfer of an upper layer packet on a side of a user terminal corresponding to an upper layer packet address and a lower layer frame on a side of an optical wavelength path corresponding to a lower layer frame

address on the basis of an address management table which manages correspondence between the upper layer packet address and the destination lower layer frame address, to execute:

the route setting function step of setting, of optical wavelength paths of the photonic network, an optical wavelength path formed from a cut-through optical wavelength path which has a guaranteed band and directly connects packet transfer apparatuses of transmission source and destination in accordance with an optical wavelength path connection request received from the transmission source user terminal through the packet transfer apparatus; and

the external device management function step of registering correspondence between the upper layer packet address of the user terminal and the lower layer frame address corresponding to the optical wavelength path in the address management tables of the packet transfer apparatuses of the transmission source and destination in setting the optical wavelength path.